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XXX. *Of the Light produced by Inflammation.*

By George Fordyce, M. D. F. R. S.

R. May 9, 1776. **W**HEN a body is heated to a certain degree, it becomes luminous, and is said to be ignited. One of the means of producing heat is inflammation; and this, as is well known, is sufficient for ignition. But, I apprehend, that, besides the light produced by ignition, there is also light produced by the inflammation itself. For the investigation of this principle, it will be necessary to consider ignition in the first place.

Substances, heated to between 6 and 700° of FAHRENHEIT's thermometer, begin to be luminous in the dark. If they be colourless, the light which is first observed is red; as the heat is increased, there is a mixture of yellow rays; and, lastly, a due proportion of all the coloured rays to form a pure white, which has been commonly called, by chemists, a melting heat. The intenseness of this light depends much upon the density of the heated body; for, while metals, heated to this degree, throw out a strong light, the vapour at the end of the flame of a blow-pipe, properly applied to a lamp, is not visibly luminous, though the heat be so great as immediately to give a white heat to glass. The colour of this light is
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affected by the colour of the ignited matter. While *zinc* is calcining, the pure white *calx* throws off a light, which vies with that of the Sun in brightness and purity; the green *calx* of copper gives to the flame of a fire, in which it is calcining, a beautiful green; and tallow burning in a candle, being converted into empyreumatic oil, as it passes off from the wick, the yellow colour of this oil gives a yellowness to the flame, which very much alters the colours of objects seen by candle-light from what they appear to be in the day.

The light produced by the decomposition of bodies in inflammation is totally independent of the heat, and its colour is blue; for substances which burn, without producing 600° of heat of FAHRENHEIT's thermometer, give light during their inflammation. Thus, *phosphorus* of urine exposed to the air burns and is decomposed, producing light with very little heat; and that this is a true inflammation and decomposition appears from this experiment. Take a receiver of white glass, capable of holding six or eight gallons; put into it a drachm of *phosphorus* of urine, finely powdered, and half an ounce of water; cork the mouth of the receiver, and tie it over with a bladder, so as to exclude the external air; incline the receiver to all sides gently, and afterwards set it to rest; the powder will adhere to the sides, and the water will drain from it. As soon as the water is sufficiently drained off, the particles of the *phosphorus* will become luminous, and emit a thick smoke: this will continue for some days; but at last no more light or vapour will

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appear. Open the receiver, and you will find, that the air will have contracted, as it does from the inflammation of a candle in VAN HELMONT's experiment; that is, about a twentieth part. It is become unfit for inflammation; for if a lighted candle be immerfed in it, it will be extinguished as well as the *phosphorus*, and an animal will be suffocated by it. The air then has suffered the same change, as that air which has served for the inflammation of other bodies; and the *phosphorus* is partly decomposed, the water in the receiver being impregnated with its acid, and the air saturated with its phlogiston. Blow fresh air into the receiver, and the light and smoke will immediately re-appear. In like manner, it is known, that sulphur will burn and give light, without heat sufficient for ignition. Take a piece of iron heated nearly red hot, and throw a little gun-powder upon it. If the heat be of a proper degree, the sulphur will burn off with a blue flame, without heat sufficient for ignition; for, if such heat had been produced, the gun-powder would certainly have taken fire, which it does not. It is the inflammation and decomposition of the sulphur, and not its evaporation, which produces the light; for, if we sublime sulphur in close vessels, made of the most transparent glass, no light will be visible, except at the very beginning, when a small portion of it burns till the air in the vessel be saturated, and rendered unfit for inflammation.

That the light, which is produced by the decomposition in inflammation, is blue, in whatever degree of heat
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the inflammation takes place, appears from observing the bottom and lower part of the flame of a candle, where the inflammation is; the light produced is blue. Or take a candle which has burnt for some time, extinguish it by applying tallow to the wick, and let it stand to cool; afterwards set it on fire by the flame of another candle: at first, no more vapour will arise than can be acted upon by the air at once; inflammation, therefore, will go on in the whole small flame, and it will be blue. It may be necessary to observe here, that, when a candle burns, the following process happens. The tallow boils in the wick, and is converted into empyreumatic oil, rising from it in the form of vapour. As it rises from every part of the wick, the volume is increased till it comes to the top, and gives to the lower part of the flame the form of a *frustum* of an inverted cone. The air is applied to the outer surface of the column of vapour, and, there decomposing the empyreumatic oil, produces heat and blue light; the *stratum* of vapour, within the outer burning surface, is heated white-hot; the heat diminishes towards the center, which, if the flame be large, is scarcely red-hot; as the column rises, decomposition taking place constantly on its surface, it necessarily diminishes, and the upper part of the flame is conical. That the tallow boils in the wick can be seen; that it is converted into empyreumatic oil is proved by drawing the vapour, rising in the middle of the flame, where it does not burn, into a glass tube; the empyreumatic oil condenses. This also shews, that the flame does not burn in the middle. That the heat is

produced on the outer surface appears, if we take a small rod of glass, and put the end of it in the blue flame on the surface; it will be heated white-hot and melt. Immerse the rod into the flame, so that the point shall be in the center, it will melt and bend, where it is in the blue flame on the surface; whereas, if the flame be large, the point which is in the center will hardly be heated red-hot. That the empyreumatic oil is decomposed is proved by burning a candle with a very small wick in distilling vessels, no condensation of empyreumatic oil takes place. We may conclude, therefore, that light is produced by the decomposition, as well as by the ignition, in inflammation.

I will not take up the time of this learned Society in applying these principles to the explanation of various appearances in burning bodies; or ground upon them any practical rules for producing strong or faint, white or coloured light, these being sufficiently obvious. I have chosen to illustrate this subject by experiments that may be the most easily tried; but, lest the manner of powdering *phosphorus* should not be known, I will give the process. Take *phosphorus* of urine two drachms; put it into a four-ounce phial; pour upon it three ounces of water; heat it gently, by immersion in warm water, till the *phosphorus* melts; shut the phial with a cork; take it out of the water, and shake it briskly till it be cold; the *phosphorus* will be found in powder.